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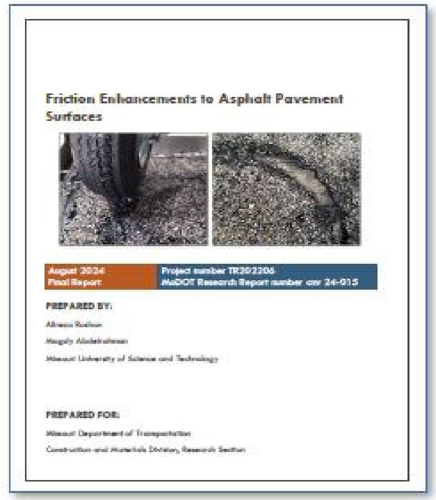
# Research Summary




## Friction Enhancements to Asphalt Pavement Surfaces

Missouri Department of Transportation (MoDOT) has used high friction surface treatment (HFST) since 2013 to restore pavement surface friction where traffic has worn down pavement surface aggregates and to improve wet crash locations. Conventional HFST application consists of a polymer resin layer, which is used to bond the pavement with high abrasion, high angularity and texture, and polish resistant aggregates (e.g., Calcined Bauxite (CB) / (chat, slag)). Construction routines and pre-existing pavement conditions affect the performance of HFST made with polymer resin. Highway agencies examine existing pavement surface conditions before determining whether HFST can be used, as it is not intended as a repair for surface distress conditions, such rutting. The relatively high cost of constructing, and removing, HFST with polymer resins along with the durability concerns due to existing pavement conditions, has led state agencies to consider high friction surface treatment with asphalt-based binders as an alternative.

This research is focused on evaluating the performance of HFST applications made with asphalt-based binders as alternatives to polymer resins (epoxy) binders. This study provides testing data and performance information on selected binder-aggregate combinations including asphalt-based Polymer-modified binders that were developed and tested in HFST applications.

Three categories of aggregate testing were followed in the experimental program: the first category was for the physical properties testing, the second category was for durability testing, and the third category was for performance testing. The analysis of testing data revealed variations in binder performance based on aggregate size and type, directly impacting both frictional properties and economic feasibility. The study highlighted the critical role of binder selection in maximizing frictional performance and economic efficiency. The findings suggest that while epoxy resin offers excellent performance for certain aggregates and conditions, modified PG binders, particularly in specific ratios, provide a balanced solution for both friction and cost across varying aggregate sizes and types.

*"Modified binders showed promising performance in various scenarios."*

The researchers developed a simple Life-Cycle-Cost (LCC) process using Excel to calculate the Net Present Value (NPV) for HFST applications based on BP, DFT, or CTM results. The major input data for the LCC program were categorized into material and project specifics.  Performance

prediction models were used to convert the input data into Skid Number (SN) values. The predicted terminal SN was compared with the recommended terminal SN using rehabilitation matrix. This matrix was proposed based on the predicted and recommended terminal SN values. Finally, the output data were calculated; these data presented the NPVs for the HFST applications. Based on the lowest NPV, the best HFST application was selected.

The presented data and conclusions of this study will assist MoDOT in enhancing road safety by using the appropriate HFST at a reduced cost. The outcomes of this study shall assist MoDOT in identifying possible alternative asphalt binder-aggregate combinations that provide comparable frictional characteristics to those of the current HFST practices with Calcined Bauxite and epoxy resin and provide comparable performance.

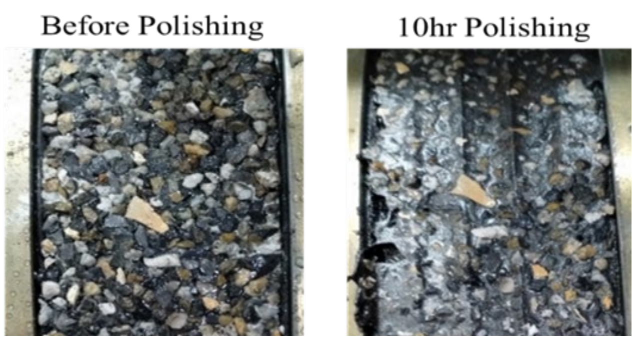



**Figure 1: Calcined Bauxite HFST size with Emulsion (CRS-2P), British Pendulum coupons.**

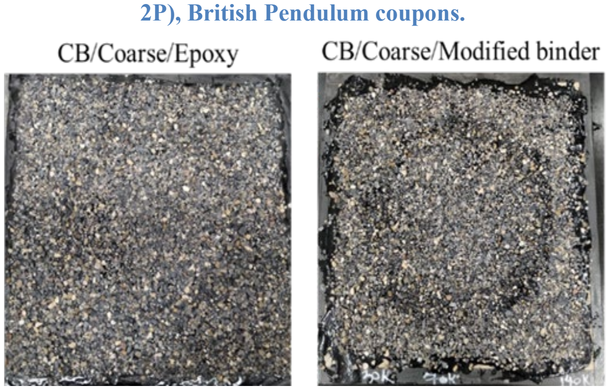



**Figure 2: Slab with Epoxy and asphalt-based binder after 140K polishing cycles, Three-Wheel Polishing Device.**

| ***Project Information*** |
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| **PRINCIPAL INVESTIGATOR:** Dr. Magdy Abdelrahman |
| **REPORT NAME:** Friction Enhancements to Asphalt Pavement Surfaces |
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